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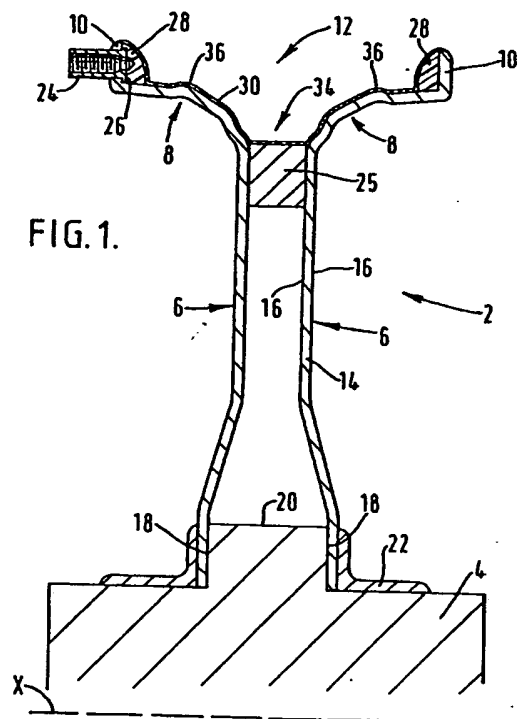
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GB 1602106 GB 1265962  
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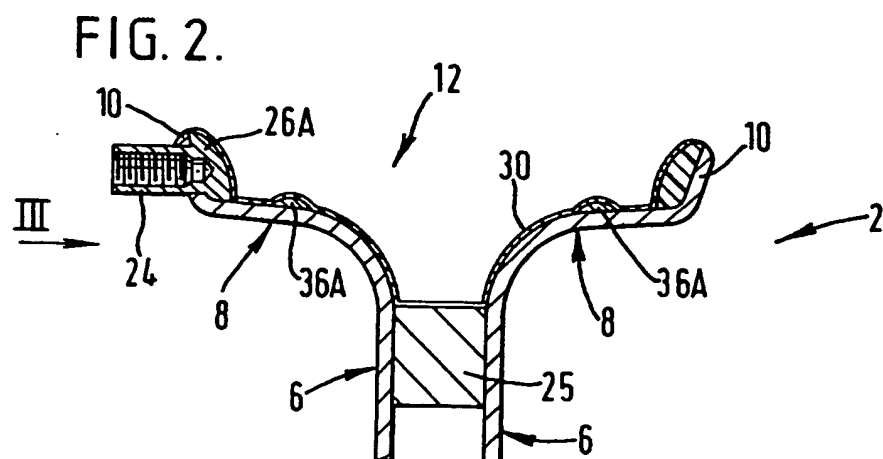
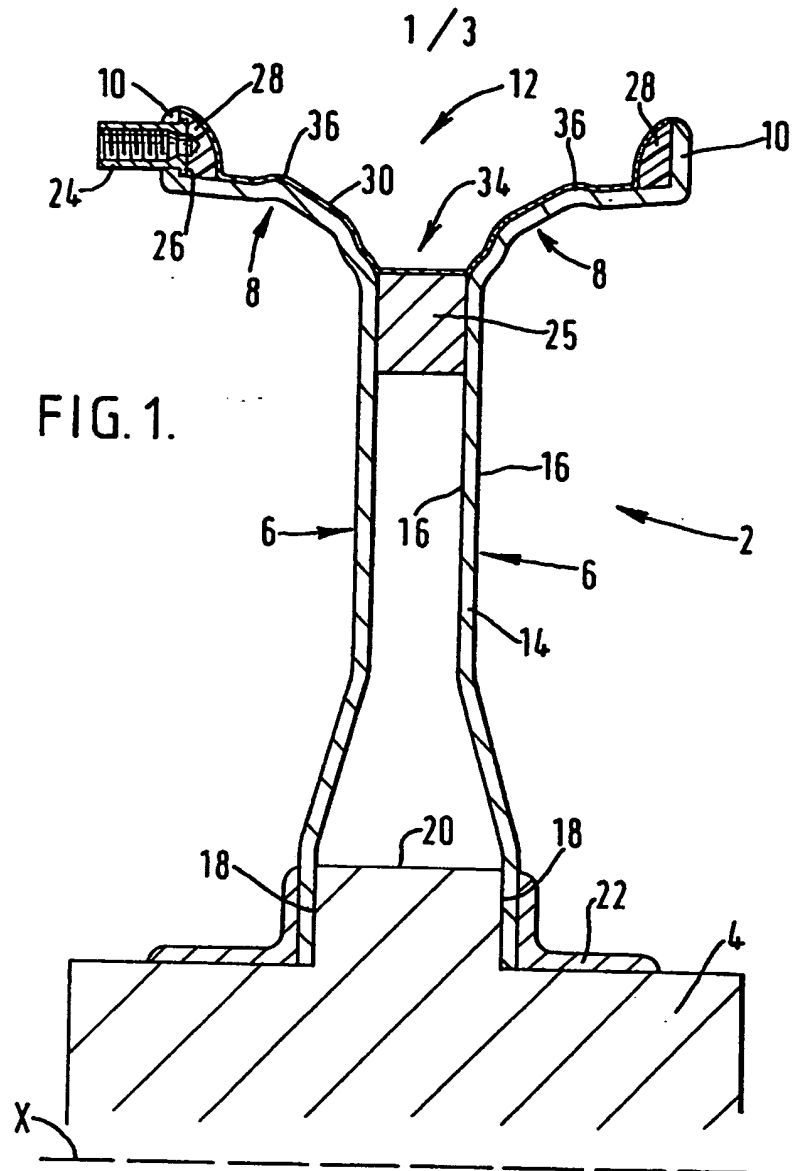
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## (54) Disc wheel

(57) A wheel, for example, for a racing motorcycle, comprises a central hub 4 to which are bonded encircling discs 6 spaced radially outwardly by a bonded annulus 25. The discs 6 comprises flanges 8 providing a rim to receive a pneumatic tyre. Each disc 6 is formed by a metal-walled honeycomb structure 14 sandwiched between bonded layers 16 of epoxy resin reinforced by plies of woven carbon fibre fabric. The honeycomb structure 14 has cell walls of aluminium alloy. A similar honeycomb structure can form the annulus 25.



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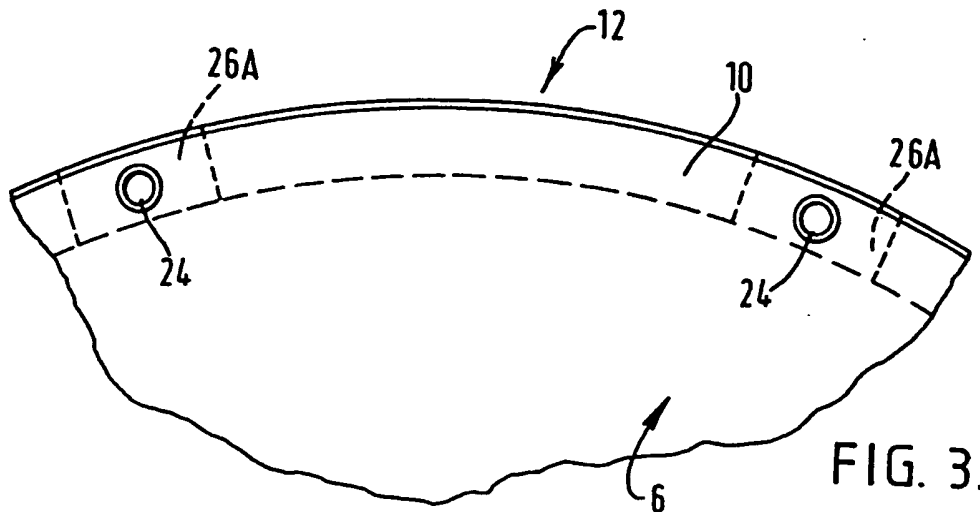


FIG. 3.

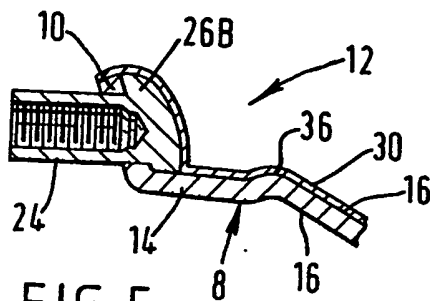


FIG. 5.

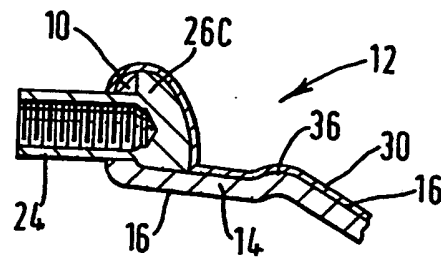


FIG. 6.

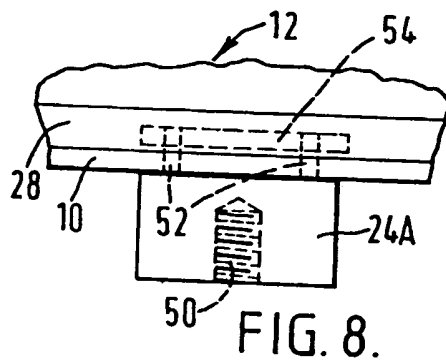


FIG. 8.

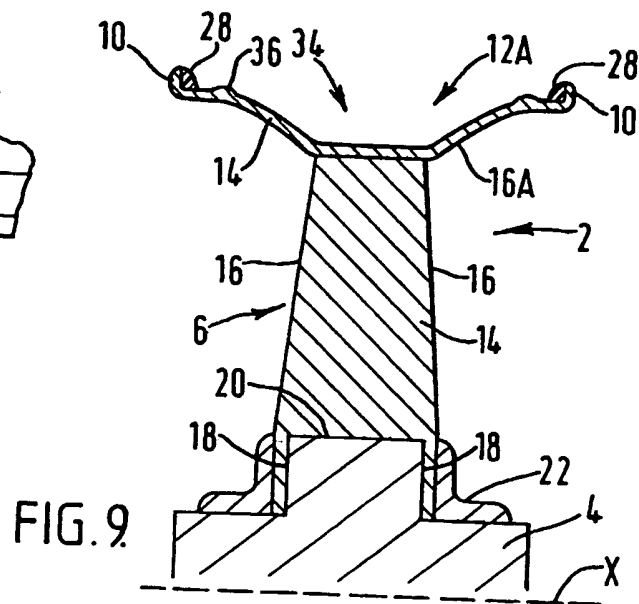
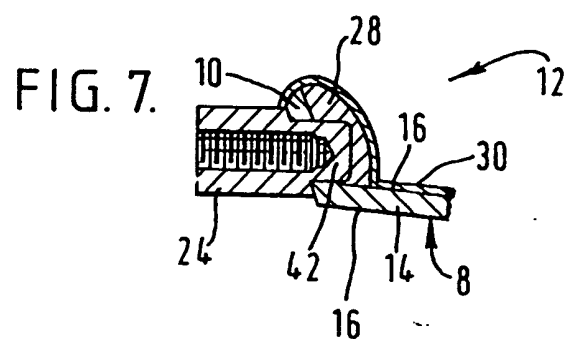
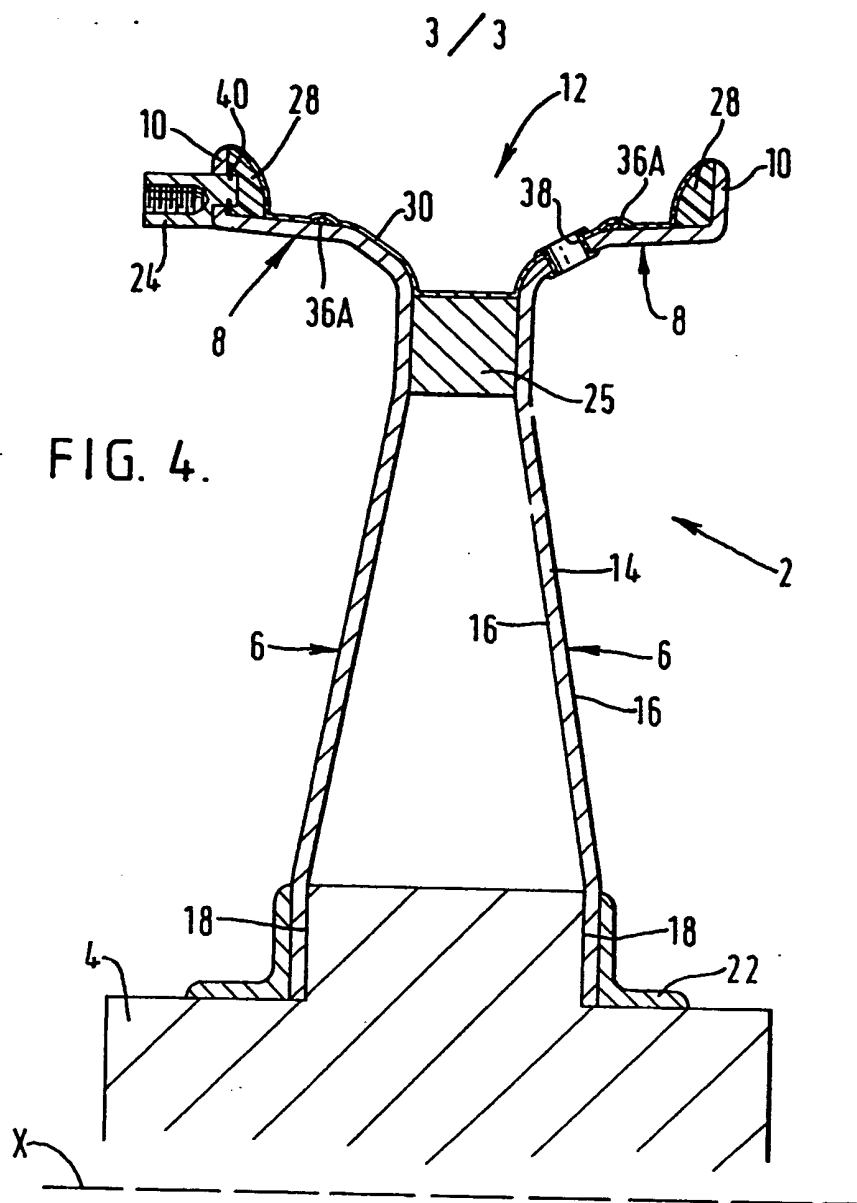


FIG. 9



## SPECIFICATION

## Vehicle road wheel

5 This invention relates to road wheels for road vehicles, and particularly though not exclusively concerns motorcycle road wheels.

An object of the invention is to provide a road wheel which can be light in weight but strong.

10 According to the invention a road wheel for a road vehicle comprises a central hub, an annular rim to receive a road running tyre, said rim surrounding and being co-axial with the hub, supporting means extending between the hub, and said supporting means and/or rim comprising a composite material comprising a metal walled honeycomb structure with fibre reinforced synthetic resin adhered to the structure.

Although either the supporting means or the rim 20 may comprise the composite material, preferably both comprise the material.

The metal is preferably a lightweight metal, for example an aluminium alloy, the fibre reinforcement may be carbon fibre, and the synthetic resin may be 25 epoxy resin.

The supporting means may comprise one or more discs co-axial with the hub, or the supporting means may be a plurality of spokes.

Other features or advantages of a wheel formed in accordance with the invention will be apparent from the following description given, by way of example, with reference to the accompanying drawings in which:

35 *Figure 1* is a diagrammatic and fragmentary view on a diametral plane cut short by another diametral plane at right angles, of an embodiment of a road wheel formed according to the invention;

*Figure 2* is a fragment of a view similar to *Figure 1* of another embodiment formed according to the 40 invention;

*Figure 3* is a fragmentary side view in the direction of arrow III in *Figure 2*;

*Figure 4* is a view similar to *Figure 1* of a preferred embodiment of a road wheel formed according to 45 the invention;

*Figures 5, 6 and 7* respectively show in diagrammatic cross-section further alternative means which can be employed for mounting a brake disc on the rim;

50 *Figure 8* is a fragmentary plan view of a wheel formed according to the invention showing yet further alternative means employed for mounting a brake disc on the rim; and

*Figure 9* is a view similar to *Figure 1* of another 55 embodiment of wheel formed according to the invention.

In the following description like or comparable parts are identified by the same reference numerals.

60 Referring to *Figure 1* a front or rear road wheel for a motorcycle, for example a racing motorcycle, is shown at 2 for rotation about an axis X. The wheel has a central hub 4 of metal, for example an aluminium or magnesium alloy to receive bearings 65 (not shown) accommodating the usual axle.

The wheel comprises a pair of spaced symmetrically disposed annular discs 6 centred on the axis X and formed at their radially outward edge portions with integral annular flanges 8 having annular edge 70 ribs 10 so that in combination the flanges form a wheel rim 12 centred on axis X to receive a pneumatic tyre (not shown).

Each integral disc and flange 6, 8 is formed of a composite material in which a honeycomb structure 75 14 having its cell walls formed of lightweight metal is sandwiched between layers 16 of synthetic resin reinforced by fibre material strongly bonded by the resin to the structure 14. For example, the honeycomb structure 14 may define passages or cells of an hexagonal shape in cross-section, and can be 80 formed of an aluminium alloy which may contain about 97% aluminium and about 2.5% chromium. Axes of adjacent aforesaid passages or cells may be substantially parallel one to another, and one or 85 more of the axes may extend transversely to the plane of that portion of a said layer 16 which is adjacent to the passage or cell; for example, the axis may intersect said portion at substantially 90°C. The resin can be epoxy resin, and the fibre material can be carbon fibre.

The combined disc and flange 6, 8 may be formed by interleaving the honeycomb structure between layers of carbon fibre material carrying pre-preg resin, then applying pressure, for example, by an 95 air-bag technique, to make the sandwich of structure 14 and layers 16 conform to the shape of the flange and disc, and subsequently heat curing the resin.

Each layer 16 can comprise two superposed plies of woven carbon fibre material. The warp and weft in 100 either ply are at substantially a right-angle and the two plies laid so that the warp and weft in one ply is at substantially 45° to both the warp and weft in the other ply to enhance the strength of the composite material in all radial directions. If desired additional 105 plies of carbon fibre material can be included in one or more of the layers 16. For example, any such additional ply may extend for some distance from the central opening in a said disc 6 towards the rim 12.

110 Adjacent to their central openings, the discs 6 are bonded to opposite facing radial faces 18 of an annular shoulder 20 or other abutment arrangement on the hub, and the discs are furthermore secured to the hub using flanged retaining rings 22 each 115 bonded to both the corresponding disc and the hub.

At the radially outermost portions of the disc 6, the disc are spaced and the wheel strengthened by an annular spacer 25 substantially centred on the axis X. The spacer 25 is bonded to internal faces of the 120 discs 6 and can be formed of a honeycomb structure having its cell walls of lightweight metal similar to the structure 14. If desired the spacer may have one or more layers of fibre, for example, carbon fibre, reinforced resin adhered to the honeycomb structure.

Using such a construction wheels of any desired axial width may be made using a pair of standard integral disc and flange combinations 6, 8 simply by 130 choosing a hub having faces 18 axially spaced by a desired dimension and by forming the spacer 25

with a desired axial dimension.

The hub 4 may be modified to incorporate a brake drum, a brake disc for a disc brake may be secured to the hub or to the hub and a said disc 6.

5 In Figure 1, however, one of the ribs 10 is adapted by provision thereon of an annular array of substantially equip-angularly spaced sleeves 24 of metal, for example, aluminium alloy, internally screw threaded to receive bolts (not shown) securing to the rim 12 an  
10 annular brake disc of a kind known in racing having relatively larger inner and outer diameters. Each sleeve 24, which is bonded to a said rib 10 passes through an opening in the latter and has a relatively small head 26 engaged behind the rib. A profiled  
15 beading 28 in an annular disposition is bonded to a said flange 8 behind the corresponding edge rib 10. This beading may be of a plastics or resin material or be formed of a honeycomb lightweight metal structure similar to the structure 14. The head 26 is  
20 embedded in the left-hand side beading 28 in Figure 1.

For additional strength and improved finish a further layer 30 of fibre reinforced synthetic resin is the axial width of the rim to cover the beadings 28  
25 and to provide a base for the rim well 34 by extending over the spacer 25 to which latter the layer 30 is also bonded. Layer 30 preferably comprises a plurality of superposed plies of carbon fibre material. For example, the radially innermost ply may be  
30 woven carbon fibre material and one or more radially outer plies of carbon filaments disposed longitudinally side by side and extending lengthwise along the circumference of the rim 12. Therefore, the combination of the shoulder 20, discs 6, spacer 25,  
35 and layer 30 provides for the rim a strong support akin to a box section.

Each combined rib 10 and beading 28 forms a rim lip for retaining a beading of the pneumatic tyre. The flanges 8 are also formed with additional annular  
40 ribs 36 which prevent the tyre slipping into the well 34.

A wheel formed as above described can have excellent streamline properties.

To lighten the wheel, apertures may be formed  
45 through the discs 6.

In one modification the rim may be of a solid metal construction of annular form and channel shaped cross-section secured to the spacer 25 and discs 6.

In another modification the rim is of the composite  
50 material but the discs may be of a solid metal construction or the discs replaced by spokes which may be of a honeycomb structure having its cell walls formed of a lightweight metal similar to the structure 14 having adhered to at least one side of  
55 the structure a fibre (for example, carbon fibre) reinforced resin.

In the embodiment in Figure 2, the sleeve 24 has a relatively large head 26A profiled similar to the beading 28 and, as shown in Figure 3, extending  
60 arcuately some considerable distance to either side of the sleeve to better resist the sleeve from being pulled from the rib 10 and to distribute the load on the rib caused by braking. The arcuate spaces between the heads 26A are filled by beading  
65 similar to 28. In Figure 2 the ribs 36 of Figure 1 are

replaced by annular inserts 36A of plastics or resin each bonded to the corresponding flange 8 before application of the layer 30.

In Figure 4 a preferred embodiment is shown in  
70 which the discs 6 diverge along the radially inwards direction from the spacer 25 to the hub.

Also in Figure 4 one of the flanges 8 is shown with an aperture lined with a grommet 38 to receive an inflation valve for the tyre. The sleeve 24 is engaged  
75 by a circlip or ring 40 engaging the adjacent rib 10.

In Figures 5 and 6 the sleeves 24 have respective large heads 26B and 26C comparable with the head 26A of Figure 2.

In Figure 7 the beading 28 is of resin into which a spigot 42 on the sleeve 24 is sunk and bonded.  
80

In Figure 8, a brake disc can be bolted to a plurality of elongate, for example, rectangular metal blocks 24A (only one shown) spaced round the rim 10, each formed with a threaded bore 50 to receive a disc  
85 mounting bolt. A plurality of projections 52 passing through the rib 10 are attached firmly to the block 24A which is clamped firmly against one side of the rib 10 due to a support plate 54 being secured to the projections at the other side of the rib. The support  
90 plate and projections 52 are potted or sunk in the beading 28. The projections are secured to the support plate 54 in any desired manner, for example, they may be threaded studs to which nuts are fitted, or the projections may have their ends deformed to  
95 form rivet heads, or they may be adhesively bonded to the support plate. If desired the block 24A and/or the support plate 54 may be adhesively bonded to the rib 10.

In the embodiment in Figure 9 the annular rim 12A  
100 is bonded to the outer periphery of a single axially thick disc 6 bonded at its central opening to the hub 4. In the honeycomb structure 14 of the disc 6 the axes of the cells may be substantially parallel to the axis X. The rim 12A can be formed by honeycomb  
105 structure 14 to which at least one layer 16A of fibre reinforced resin is bonded. The layer 16A can be bonded around and across the rim well 34 between the ribs 10 and in addition to that other layer, or instead of it, a layer similar to the layer 30 (Figure 1)  
110 can be bonded to the rim well.

Wheels in accordance with the invention may be made for other road vehicles having more than two road running wheels.

## 115 CLAIMS

1. A road wheel for a road vehicle comprising a central hub, an annular rim to receive a road running tyre, said rim surrounding and being co-axial with  
120 the hub, supporting means extending between the hub and rim to support the latter in relation to the hub, and said supporting means and/or rim comprising a composite material comprising a metal walled honeycomb structure with fibre reinforced synthetic resin adhered to the structure.

2. A wheel as claimed in claim 1, in which honeycomb structure defines passages or cells of an hexagonal cross-section shape.

3. A wheel as claimed in claim 1 or 2, in which  
130 the metal is an aluminium alloy.

4. A wheel as claimed in any one preceding claim, in which the fibre is carbon fibre.
5. A wheel as claimed in any one preceding claim, in which the supporting means and/or rim comprise(s) said composite material in which the honeycomb structure is sandwiched between layers of the fibre reinforced resin.
6. A wheel as claimed in any one preceding claim, in which the fibre reinforcement is in the form of a woven material.
7. A wheel as claimed in claim 6, in which at least two superposed plies of the woven material are adhered to at least one side of the honeycomb structure, and the weft and warp of one ply both extend transversely to both the weft and warp of the other ply.
8. A wheel as claimed in any one preceding claim, in which the supporting means comprises a disc formed of said composite material and mounted co-axially with the hub.
9. A wheel as claimed in any one of claims 1 to 7, in which the supporting means comprises a pair of spaced discs formed of said composite material and mounted co-axially with the hub.
10. A wheel as claimed in claim 9 having spacing means formed of at least a metal walled honeycomb structure adhered between the discs.
11. A wheel as claimed in claim 10, in which said metal walled honeycomb structure of the spacing means defines passages cells of an hexagonal cross-section shape, and/or metal walls of the honeycomb structure of the spacing means are of aluminium alloy.
12. A wheel as claimed in any one of claims 9 to 11, in which over at least a portion of the supporting means said discs diverge along a direction directed radially inwardly towards the hub.
13. A wheel as claimed in any one of claims 8 to 12, in which the disc or discs is/are adhered to the hub.
14. A wheel as claimed in claim 13, in which the or each disc is adhered between an abutment on the hub and a retaining ring.
15. A wheel as claimed in any one of claims 9 to 12, or as claimed in claim 13 or 14 when either is appended to claim 9, in which between the hub and rim at least one of the discs is apertured.
16. A wheel as claimed in any one of claims 1 to 7, in which the supporting means comprises a plurality of spokes of said composite material.
17. A wheel as claimed in any one preceding claim, in which the rim comprising said composite material comprises an annular well having a base comprising fibre reinforced synthetic resin.
18. A wheel as claimed in claim 17, in which the base comprises carbon fibre reinforced resin.
19. A wheel as claimed in any one preceding claim, in which the rim comprising said composite material has lips at edges of the rim, a said lip being provided with means for mounting a disc of a disc brake on the lip.
20. A wheel as claimed in any one of claims 9 to 12 or in claim 15 or as claimed in any one of the claims in a group of claims consisting of claims 13, 14 and 17 to 19 when each of the claims in that group

is appended to claim 9, in which said discs have flanges of said composite material to provide the rim.

21. A road wheel for a road vehicle substantially as hereinbefore described with reference to Figs. 1 to 3, or 4, or 9 of the accompanying drawings, or substantially as hereinbefore described with reference to Figs. 1 to 3, or 4, or 9 when modified substantially as described with reference to Fig. 5, or 6, or 7, or 8 of the accompanying drawings.

22. A motor vehicle having one or more road wheels as claimed in any one preceding claim.

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